BOOK REVIEWS

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Butterflies and Climate Change.—Roger L. H. Dennis. 1993. Manchester University Press, Manchester, U.K. 302 pp. Price.

This scholarly book offers a comprehensive review of our knowledge of British butterfly ecology, with particular reference to distribution and abundance correlated with extrinsic environmental variables. The book is encyclopedic and technical, providing summaries of major ecological studies of British butterflies and British weather, past, present and future. It is illustrated with 16 data tables and 40 journal-type figures. Perhaps its greatest asset is its tremendous bibliography, comprising 51 pages of citations, which I estimate to list nearly 1,000 publications. Dennis employs a dry, occasionally idiosyncratic writing style, and commands such a scope of material that the connections between themes and the crux of his argument are often submerged in detailed but tangential lacunae. This is especially so in the sections discussing the evolution of morphological and life-history attributes such as unpalatability, wing coloration and polyphenism. I cannot see the immediate relevance of Papageorgis' (1975) neotropical microhabitat stratification by mimicry groups to the proximate effects of rapid global warming on butterfly populations. The book has two additional deeply engrained flaws which I felt detracted from the general importance of its message: geographical provincialism and heavy reliance on correlation matrices for inferring causation. These criticisms will be elaborated after a brief chapter content summary.

Chapter One, "Atmospheric Systems and Butterfly Biology," begins with a review of mechanisms of weather and climate, then moves to a lengthy discussion of adult and larval thermoregulation in butterflies, and its relation with numerous life-history components (e.g., feeding, fecundity, avoidance of predators). Chapter Two, "Climate, Butterfly Populations and Distributions," spans a hierarchical range of topics, from individual life history strategies and phenology, through population ecology and demography, to patterns and determinants of geographical species diversity at the community level. Chapter Three, "Morphological Adaptations to Climatic Gradients," begins with an explication of wing pattern evolution and mimicry, then describes various gradients in morphological characters associated with climate, and ends with a discussion of seasonal polyphenism. Chapter Four, "Past Climates and Evolutionary History," combines knowledge of relatively recent (Pleistocene) climate change in Europe with hypothetical postdictions on butterfly distributions and diversification there. Chapter Five offers the promised, "Future Atmospheric Changes and Butterfly Populations: Predictions and Consequences," but focusses almost entirely on British species, and maintains a surprisingly depoliticized stance on human-induced effects and conservation issues.

Flaw 1: Provincialism.

This book should have been entitled, "British Butterflies and Climate Change." It contains 19 maps, all of Britain (three of which also illustrate Europe). The vast

preponderance of examples in the text are drawn from the palearctic fauna (87 of the 156 species listed in the index). There are two problems with this focus. First, I encountered my copy of this book on the "Environment" shelf of a university book store in New York. The back cover and preface offer no hint that it is primarily relevant only to British species. From a commercial perspective, it is clearly beneficial to market a book to the broadest possible customer base, but I find the neglect to mention Dennis' book's regional focus bordering on dishonesty. By contrast, E. B. Ford's (1990) "Butterflies" (also a deceptively vague title), states in the first sentence of both the author's and editor's prefaces that it is about British butterflies. Part of the motivation to downplay "Butterflies and Climate Change"'s provincial aspect may be the almost simultaneous publication (1992) of another book edited by Dennis, "The Ecology of Butterflies in Britain," which overlaps substantially in its subject matter with the current book.

We probably know more about the ecology of butterflies in Britain than those of anywhere else. Thus, the British emphasis in the book could be forgiven if the study of British butterflies and their ecology offered a plausible paradigm for understanding global climatic patterns and their effect on natural ecosystems. However, it is highly debatable whether this is the case. The British landscape has been so heavily trammelled by human activity for such a long time that any vestige of a "natural" baseline against which large-scale patterns of ecological change can be documented must have been thoroughly obliterated, if, indeed, a historical equilibrium state ever existed at all. The depauperate Palearctic fauna undoubtedly suffered far more from cooling during the Pleistocene than it has from global warming to date. Britain was largely covered with ice a mere 15,000 years ago, and most of its butterflies are recent immigrants from the continent: there are no endemic butterfly species, and few geographical races differentiated substantially from continental populations (of three recognized "British forms" (Ford 1990), *Papilio machaon britannicus* is rare and protected (Collins and Morris, 1985), while *Lycaena dispar dispar* has been extinct since 1848 (Higgins and Riley, 1970)). Ironically, Dennis (p. 214) predicts that "the majority of British butterflies will benefit from climatic change," a result counterintuitive to the notion that global warming is bad for biodiversity, but perhaps indicative of these species' relatively coarse degree of adaptation to their environment. In fact, contrary to the claim on the back of the book that "butterflies are particularly sensitive to climate and are important 'bioindicators' of climatic change," based on Dennis' conclusions, I suspect that speckled woods (*Pararge aegeria*) will still be flying in Oxfordshire when people are punting around East London in gondolas.

Flaw 2: Correlation vs. causation.

On p. 137, Dennis states:

> 'Correlation' and regression parameters are often not interpreted with sufficient caution, especially in multivariate designs (Vincent, 1981). Although a high (sic) significant correlation may confirm a hypothesis, it is not proof of the process modelled: other factors or links may have been omitted. Similar distribution changes in the past cannot simply be interpreted as having emanated from the same causes; equifinality is potentially rife in biotic systems. Conversely, low

correlations are not proof of the absence of a relationship say between changes in heat and distribution changes.

This is a prudent statement reflecting appropriate concern for overconfidence in deterministic processes inferred from statistical relationships. Yet somehow, this message is lost throughout the rest of the book. Dennis repeatedly erects causal hypotheses and theories for butterfly distribution based on multiple regressions and correlations with abotic factors. The book contains several complex flow charts or ecological web diagrams illustrating arrays of interrelated abiotic parameters that may or may not play a role in the fate of particular butterfly species or of butterflies in general. These relationships are interpreted causally in the text:

> The multiple correlations of morph transformations with several climatic variables and the extensive covariance among the latter are expected because of their causal association in pressure systems . . . Thus it is plausible that there is a causal link between climate and population status with increasing latitude, an indirect one may exist between populaton parameters and phenetic transformations, as well as direct links between climate and phenetics. (p. 110)

Dennis follows the unfortunate reductionist tendency in the ecological literature to ascribe general (or average) observed patterns of diversity to universal, extrinsic processes. It strikes me that intrinsic, biotic attributes of individual species (e.g., larval foodplant distribution) rather than abiotic factors may be more directly linked to the survival of butterflies in particular environments, and that changes in butterfly distribution may be cascade effects of local community changes. Thus, while rapid, human-induced climate change is surely a dire environmental problem facing the planet, many species may be more immediately threatened by proximate problems such as habitat loss and competition with introduced flora, fauna and pathogens.—*Andrew V. Z. Brower, Dept. of Entomology, American Museum of Natural History, Central Park West at 79th Street, New York, New York 10024.*

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